SUITABILITY EVALUATION OF THE ACS-1648 PARTIAL PRESSURE HELMET IN THE U-2 AIRCRAFT

JULY 1965

PREPARED BY: JOHN H. LUDWIG
Major, USAF

AIR FORCE FLIGHT TEST CENTER
EDWARDS AIR FORCE BASE, CALIFORNIA
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE

Approved For Release 2005/04/21 : CIA-RDP75B00285R000400160005-6

SUMMARY

This report presents the results of the suitability evaluation of the ACS-1648 partial pressure helmet, designed by the David Clark Company to be worn with the MC-3A type partial pressure suit. The evaluation consisted of 18 test flights flown by aircrews of the Air Force Flight Test Center under operational conditions in U-2 type aircraft during the period March through June 1965. Results of the evaluation indicated the helmet was unsuitable for extended high altitude flights because of pilot fatigue induced primarily by the helmet's excessive weight and poor suspension system. From experience gained in the evaluation, numerous design objectives were recommended for follow-on programs of partial pressure helmets. Included in these objectives were a major reduction in weight and an improved suspension system.

Approved For Release 2005/04/21 : CIA-RDP75B00285R000400160005-6

TABLE OF CONTENTS

Approved For Release 2005/04/21 : CIA-RDP75B00285R000400160005-6

INTRODUCTION

This report presents the results of the suitability evaluation tests of the ACS-1648 hard shell partial pressure helmet designed by the David Clark Company to be worn with the MC-3A type partial pressure suit. The tests were conducted in U-2 type aircraft during the period March through June 1965 in conjunction with the normal test missions of the Special Projects Operations Division of the Directorate of Flight Test Operations at Edwards Air Force Base, California. Ten aircrew members used the helmet in a series of 18 flights ranging in duration from two to five hours. In addition to evaluating the suitability of the helmet for use with the MC-3A partial pressure suit, the helmet was also compared with the MA-2 helmet presently in use by U-2 aircrews. This comparison was conducted to determine if the new helmet was an improvement over the MA-2 in the areas of comfort, mobility and visibility.

TEST AND EVALUATION

GENERAL

The test helmet was designed as a two piece unit consisting of a head unit and a neck unit (see Appendix). The primary change in the new helmet as compared to the MA-2 helmet presently in use was the incorporation of the face piece, the hard shell, and the suspension-communication unit of the MA-2 helmet into one head unit. The neck unit of the new helmet when connected to the head unit provides the necessary seal for the pilot's oxygen.

The evaluation of the helmet was conducted by seven aerospace research flight test pilots, two navigators, and one flight surgeon flying in U-2 type aircraft at altitudes above 60,000 feet. Prior to each flight, the aircrew member was briefed on the objective of the evaluation and asked to specifically evaluate the

areas of comfort, mobility, and visibility in both the unpressurized and pressurized state. After completion of each flight, the aircrew member completed a questionnaire (see Appendix) giving his evaluation of the test. Following this, the flight was discussed with the project officer. The results of the tests as obtained from a study of the questionnaire and notes taken during the debriefings are presented in the following paragraphs.

COMFORT

Good Points: The helmet was very easy to put on and take off as compared to the MA-2. It was only necessary to fasten one short zipper in the neck unit prior to slipping the helmet over the head. If necessary, the helmet could be put on or taken off without assistance from personal equipment personnel.

Adjustment of pressure on the forehead and back of the head could be adjusted by means of a knob at the right rear of the helmet. This made it quite easy to vary the pressure during flight.

Bad Points: The major disadvantage of the helmet was its weight and suspension system. The helmet weighed approximately 8.8 pounds as compared to approximately 6.6 pounds for the MA-2. The majority of this weight was concentrated on top of the pilot's head by the top part of the suspension system which was a 5" diameter foam rubber pad fastened to the top of the helmet liner. This arrangement normally produced a hot spot on top of the pilot's head after approximately one hour and a headache after two hours. This deficiency alone made the helmet unacceptable.

Another deficiency of the suspension system concerned the adjustment of the earphones. It was impossible to keep the earphones adjusted to a snug fit. Each time the pilot turned his head right or left his

ears tended to slip out of the earphones. This condition besides being bothersome caused excessive noise leaks.

Included in the suspension system deficiencies was the fit of the forehead-cheek pad. Although the pressure could be adjusted, the bottom ends of the pad became uncomfortable in time because they tended to dig into the pilot's cheeks.

Breathing under any labored condition became a noticeable effort by most pilots, especially during any emotional or physical stress. In the later part of the evaluation, the exhalation valve size was increased which partially helped to correct the condition.

VISIBILITY

Good Points: The major advantage of the helmet over the MA-2 was in visibility. The gold plated fish-bowl type visor produced both a wider visual field and a sharper image. In addition, the capability of opening and closing the visor in flight eliminated the present requirement of removing and storing the MA-2 faceplate prior to landing. These features were well liked by all pilots.

The visor was evaluated for reflection during both day and night flights and there appeared to be no significant problems. Although there were some reflections as in the MA-2 faceplate, there were none that would affect mission accomplishment.

Bad Points: The only deficiency in the visor was in defogging. During approximately 60 percent of the flights the visor would fog up on the outer edges after 30 minutes of flight with the heat at maximum. If the heat control was turned on 30 minutes prior to flight and left at maximum heat this would prevent the fogging in some cases. However, the gold plated heating system appeared definitely less efficient than

the wire type heating system in the MA-2 faceplate.

MOBILITY

Good Points: The ring-type connection between the head and neck units of the helmet increased slightly the mobility of the head, from right to left. This was true in both the pressurized and the unpressurized conditions. The mobility of the helmet in other areas appeared to be the same as the MA-2 helmet.

Bad Points: The oxygen hoses were of improper length and/or routed improperly. This condition caused the hoses to hang up on the fan on the left side of the cockpit when looking to the right rear. Because of this, the external visibility to the right rear was restricted.

The inflight feeding port was located too low in most cases. To be able to take in food properly, it was necessary to lower the head slightly inside the helmet.

CONCLUSIONS

1. The ACS-1648 helmet is unsuitable for extended high altitude operations because of pilot fatigue induced by the following conditions:

   a. Excessive weight

   b. Poorly designed suspension system

   c. Discomfort of forehead-cheek pad and earphones

   d. Difficult exhalation in breathing cycle

   e. Poorly positioned inflight feeding port

   f. Partial fogging of visor

2. The visibility, the ease of donning and doffing, and the capability of opening and closing the visor of the helmet are marked improvements over the present MA-2 helmet.

RECOMMENDATIONS

1. The following design objectives should be included in the design of any future proposed partial pressure helmet:

   a. A major weight reduction program using both lighter material and smaller communication components.

   b. A suspension system that will distribute the weight of the helmet evenly over the head and shoulders and yet still provide adequate ventilation.

   c. Earphones that are designed to fit the ears comfortably and securely under dynamic as well as static conditions.

   d. Oxygen and communication plumbing of correct length and with proper routing that will not interfere with cockpit mobility.

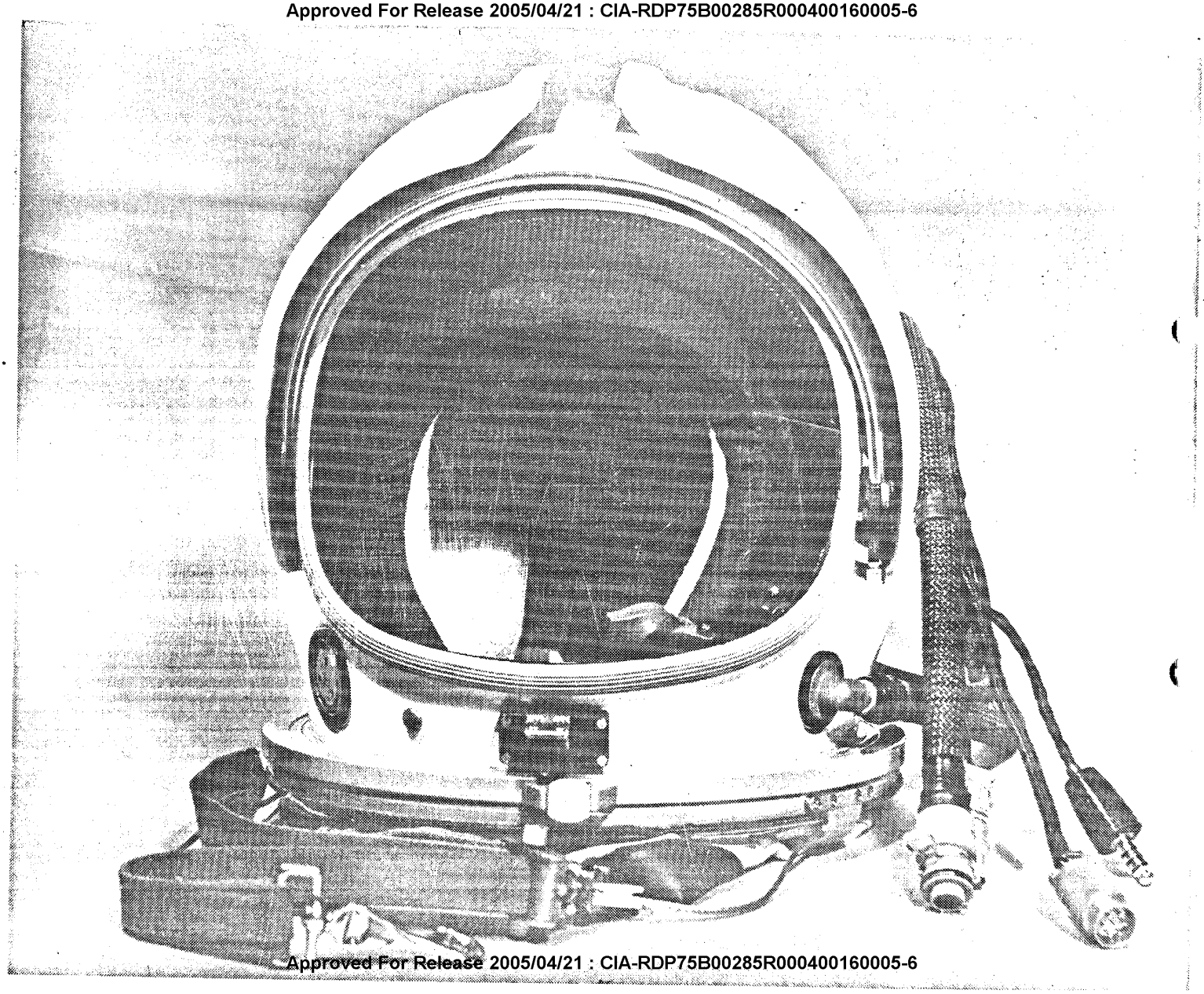
   e. A properly located inflight feeding port.

   f. An adequate exhalation valve for abnormal as well as normal breathing cycles.

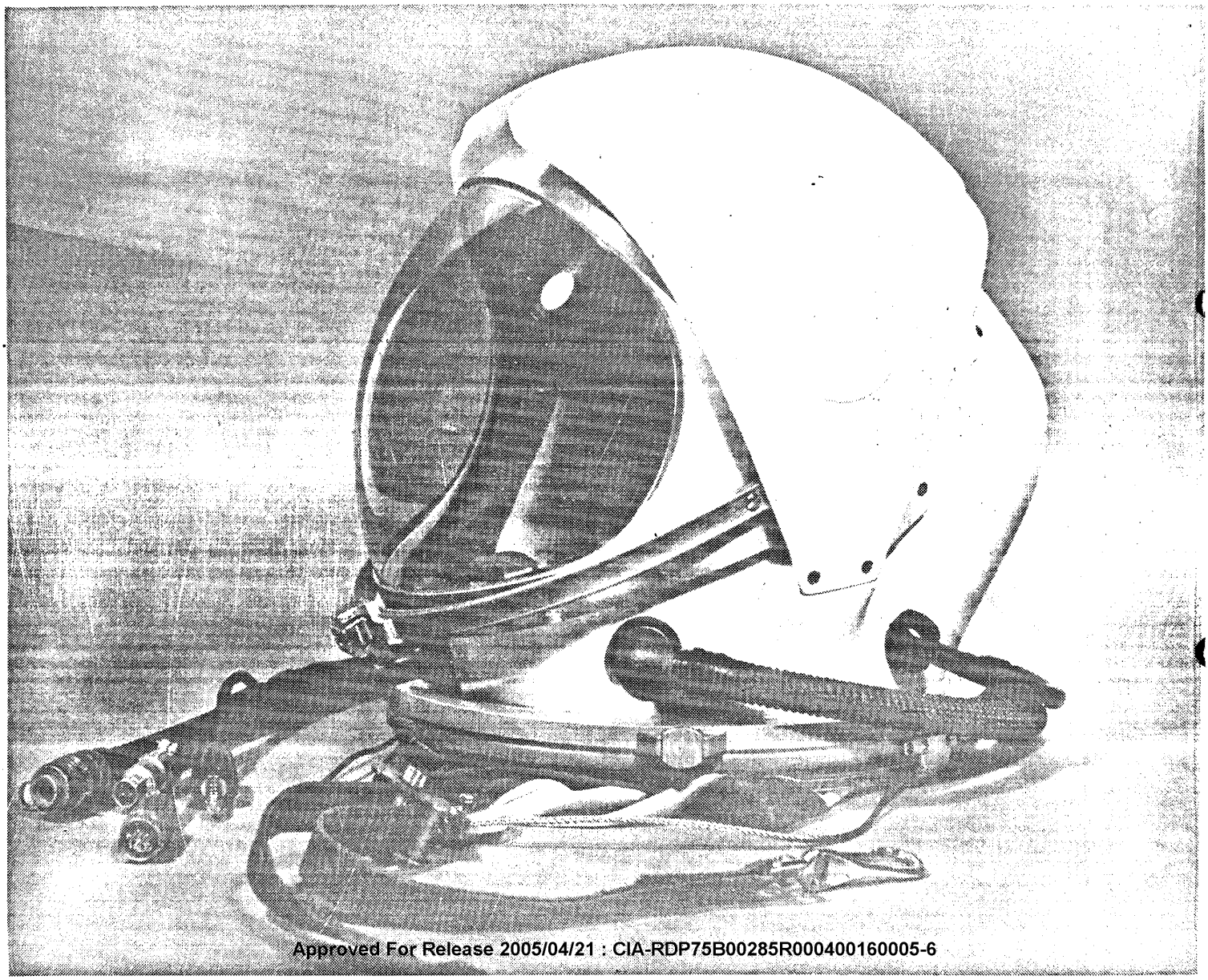
   g. A visor with features similar to those of the ACS-1648 helmet, but with an improved defogging system.

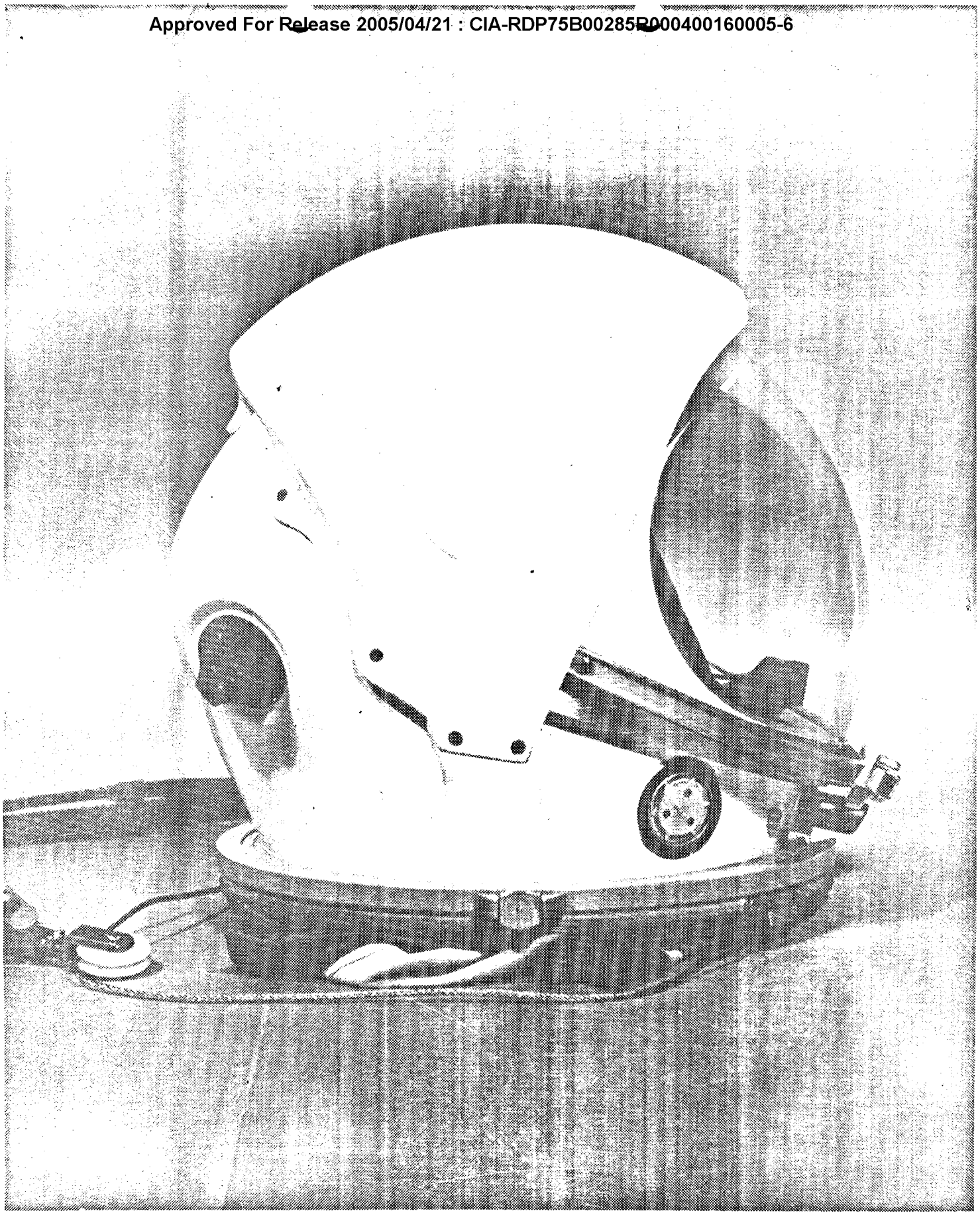
2. The manufacturer of any future helmet should run an extensive ground check and evaluation of the individual features of the helmet prior to the evaluation by the testing agency. Many deficiencies of the ACS-1648 helmet should have been noticed and corrected before the test agency ever received the helmet.

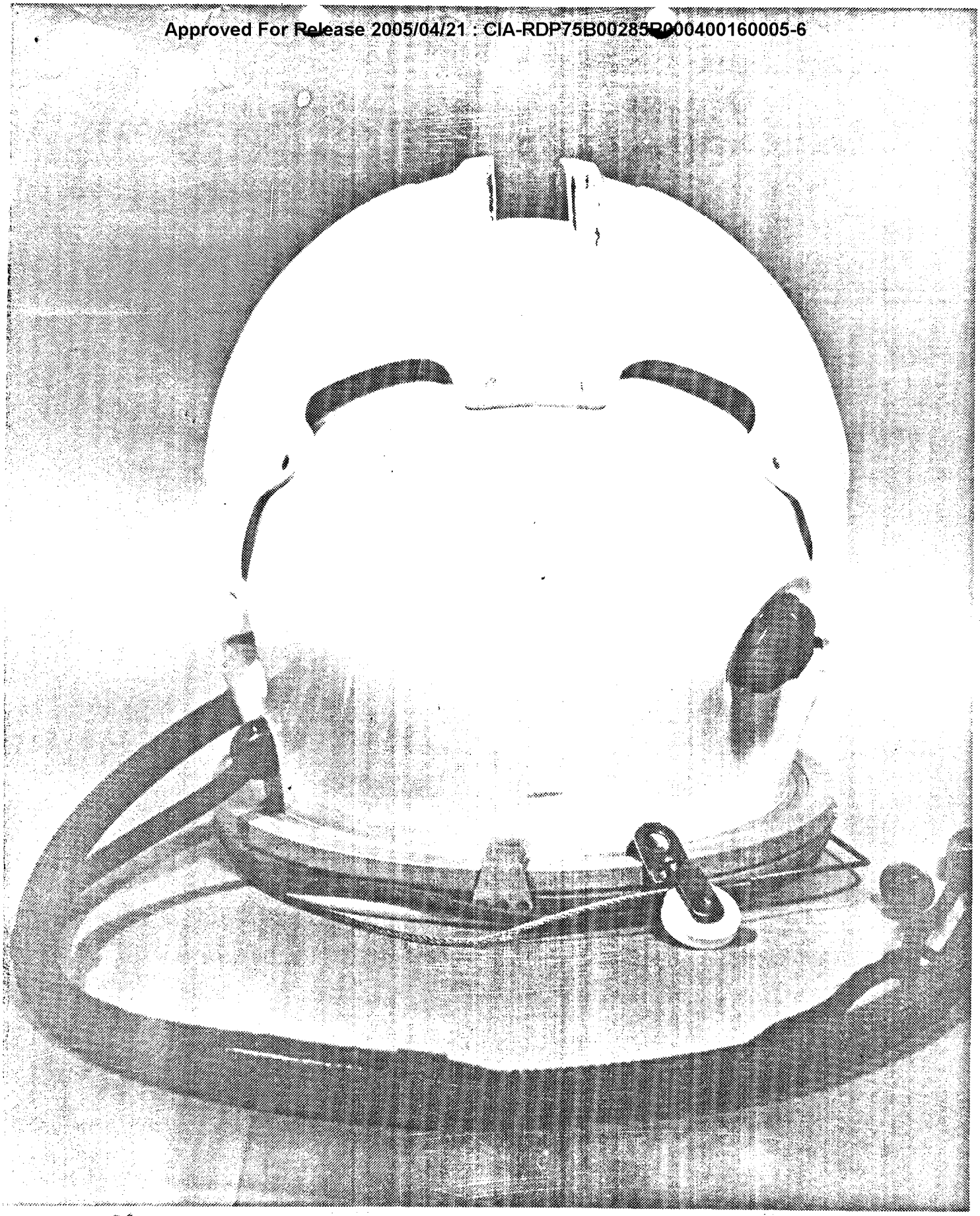
APPENDIX

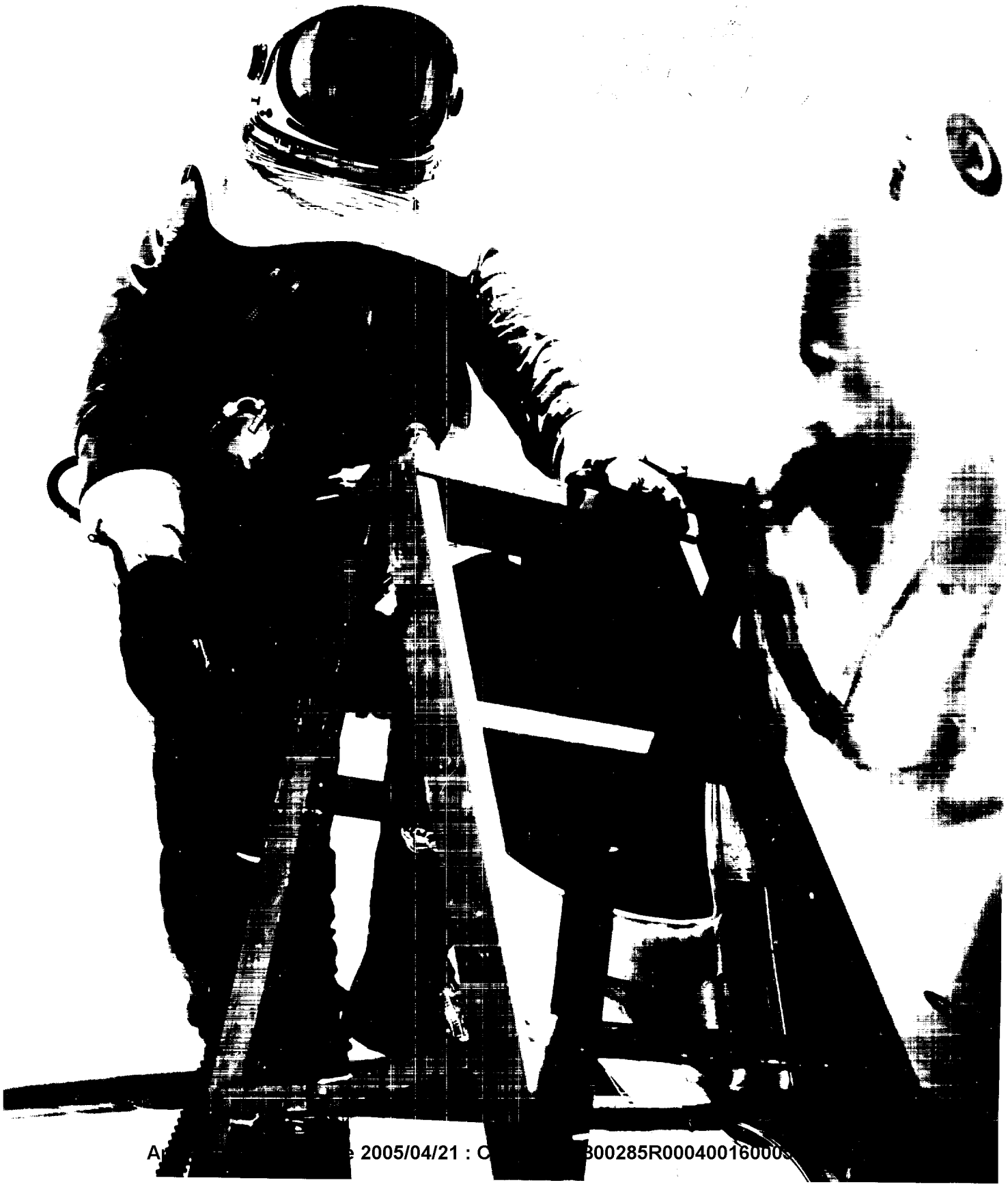


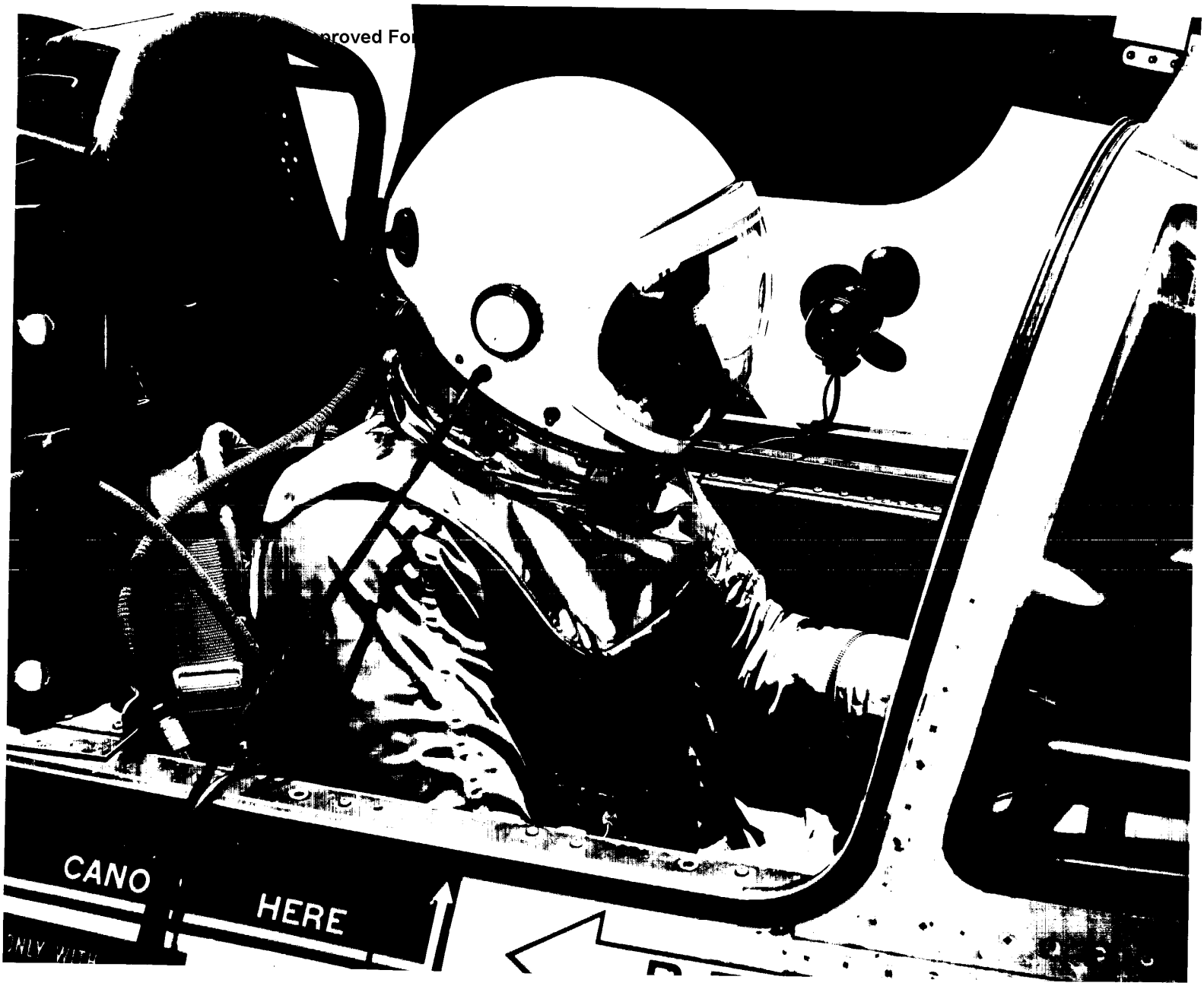
Approved For Release 2005/04/21 : CIA-RDP75B00285R000400160005-6











Approved For Release 2005/04/21 : CIA-RDP75B00285R000400160005-6

Approved For Release 2005/04/21 : CIA-RDP75B00285R000400160005-6